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MONDAY, NOVEMBER 30, 1865.—STATED MEETING.

THE VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The President delivered the following Address on the loss sustained by the Academy in the death of Sir W. R. Hamilton.

ADDRESS.

GENTLEMEN,—The death of SIR WILLIAM ROWAN HAMILTON, Andrews' Professor of Astronomy, Astronomer Royal of Ireland, for thirty-eight years a most distinguished member of the Royal Irish Academy, and formerly its President, was an event which could not be allowed to pass without public notice in this place. There was not one of his brother Academicians who did not look up to him with reverence on the ground of his wonderful genius, the vastness of his attainments, and the number and importance of his discoveries. And there were amongst us not a few bound to him by ties of an intimate friendship, who had watched his brilliant career with an affectionate sympathy, and rejoiced as each new conquest which he achieved in the fields of Science earned for him fresh laurels and a more extended fame. It is not strange, therefore, that his recent death should be lamented by all of us as a loss almost irreparable to Science, whilst within the circle of his friends it is deplored with a profound and lasting sorrow. These feelings demanded utterance. I should have been unfaithful in the performance of my duty as President—I should have been untrue to the convictions of my understanding and my heart—if I had not endeavoured to express them. If the expression be inadequate, I trust you will make allowance for the shortcomings of a speaker overpowered at once by the greatness of his theme, and by the consciousness of his inability to do justice to it.

It is not my intention here to present to you even a biographical sketch of HAMILTON or a complete outline of his character. Merely to enumerate his works, and to state with adequate fulness their subjects, would demand more time than is at our disposal. It must suffice if I bring before you the turning points in the history of his life, and briefly recall to your recollection his principal achievements as a Mathematician. Born in August, 1805, in the house of his father, Mr. Archibald Hamilton, in Dominick-street, Dublin, he gave from his infancy indications of the possession of extraordinary powers; and they were not left without wise and diligent culture. His father consigned him when less than three years old to the care of his uncle, the Rev. James Hamilton, of Trim, formerly a member of this Academy, and a contributor to its "Transactions." Under the tuition of this affectionate and able instructor he carried on his studies till he became an undergraduate in Trinity College in 1823. His career there was a most brilliant one. In every kind of trial he distanced his competitors, and justified all the expectations of his friends. But, whilst thus engaged in collegiate exercises of a comparatively elementary nature, he was already entering upon studies of greater range and elevation. A year before he entered College he had drawn up, and communicated to Dr. Brinkley, then President of this Academy, a paper on Caustics,

which was the germ of that "Theory of Systems of Rays," the publication of which first rendered HAMILTON's name celebrated amongst mathematicians. Brinkley encouraged the youthful author by his kindness, and guided him by his counsel. He communicated the paper on Caustics to the Academy, before which it was read in December, 1824, and referred to a Committee, consisting of Dr. Mac Donnell, Mr. Harte, and Dr. Lardner. Their report bore testimony to the novelty and value of the results, and the analytic skill displayed in the conduct of the investigations; but recommended the author to give a fuller development to the processes and reasonings by which his formulæ and conclusions were arrived at. Acting on this advice, he employed himself in the intervals of collegiate study in recasting and enlarging his paper, which was anew presented to the Academy, under the title of "Theory of Systems of Rays," on the 23rd of April, 1827. This memoir was in itself of the highest interest and value; so comprehensive in its method as to extend unlimitedly, and with universal success, over the whole field of optics. It also contained the germs of thought which developed themselves in works which afterwards gained for HAMILTON the highest distinction. Its table of contents announced an intention of publishing in the third part of the essay an application to dynamics of the same general principle, of which the application to optics was thus in part made public; and its third supplement contains the announcement of HAMILTON's remarkable discovery of Conical Refraction.

The Professorship of Astronomy in Trinity College became vacant in the year 1827, on the promotion of Dr. Brinkley to the Bishopric of Cloyne. Perhaps there was no incident in the life of HAMILTON more remarkable than his selection at that time to fill Brinkley's place. An undergraduate of one-and-twenty, he was preferred to rival candidates of high qualifications and influence, and the decision of the University authorities in making the appointment was ratified by the judgment of the public. It seemed to be self-evident that a man who had given such proofs of the possession of a transcendent power in dealing with the most abstract questions in mathematical physics must be the worthy and rightful successor of Brinkley. As Professor of Astronomy, two spheres of exertion belonged to him—that of lecturer upon the science, and that connected with the practical working of the Observatory. Those who have attended his lectures can bear witness to their merit. They were full of practical teaching, and calculated by their eloquence to excite in their hearers an enthusiasm for the study which they were intended to illustrate. For the business of the Observatory, it must be admitted that HAMILTON was not equally well fitted. The bias of his genius was undoubtedly to pure mathematics; but, if we estimate the total amount and value of the work which he has done—the impulse which he has given to the whole of mathematical science—we shall see little reason to find fault with that decision by which he was placed in the professorial chair, and sustained in the possession of it.

It was in 1834 that HAMILTON received the Cunningham Medal of this Academy, and the Royal Medal of the Royal Society, as the reward

of his discovery of Conical Refraction. This is admitted to have been one of the most remarkable scientific predictions that was ever made—one which announced, on the foundation of pure mathematical calculation, a physical phenomenon which was suggested by no analogy, and seemed beyond the boundaries of probability; but which, as you know, was completely verified by the experiments of Professor Humphrey Lloyd.

In 1837 HAMILTON was elected President of this Academy, on the death of Dr. Bartholomew Lloyd, who had occupied the chair for the two years succeeding the death of Brinkley. His inaugural address gave evidence of his power to direct the operations of a learned society constituted as ours is. He showed that he entered into the working of all its departments, and could sympathize with the labours of all its members. For eight years, during which he held this office, he exerted himself in every way to increase the usefulness of the Academy, and to sustain its honour; and, when he resigned the Presidentship, he received the cordial thanks of the Academicians “for his high and impartial bearing in the chair, and for his untiring efforts to advance the interests of the body.”

We have already mentioned HAMILTON’s paper on a “General Method in Dynamics.” In this memoir, starting from the idea of a characteristic function, analogous to that employed in his essay on Systems of Rays, he succeeded in giving a system of complete and rigorous integrals of the celebrated differential equations of motion of a system of bodies. This achievement gained for him the Medal of the Royal Society, and the recognition of the greatest European mathematicians. The next great work of HAMILTON of which we have to make mention, is his paper on “Algebra considered as the Science of pure Time,” a treatise of a peculiar and semi-metaphysical kind. His object in the composition of it was to establish the foundations of algebra as a science, rather than to improve its processes as an art, or to perfect its symbolism as a language. With this was connected his theory of conjugate functions, or algebraic couples, to which he was conducted in his attempts to explain some remarkable results stated by my brother, Mr. John Graves, in a paper upon imaginary logarithms. We now, in this rapid summary, pass on to his last great invention—that of the Calculus of Quaternions. Its elaboration has occupied the last twenty-two years of his life. During that time he has employed this new and powerful *organon* in discussing questions in almost every branch of mathematics. Most of his attention has, no doubt, been given to geometrical applications. But he has not failed to record in our “Proceedings” results of researches, showing that the new calculus adapts itself to the requirements of physical science. He has shown how perfectly it enables us to conceive and express, in its peculiar language, the mathematical problem of determining the orbits and perturbations of bodies governed in their motions by the Newtonian law of force. He has also shown that quaternion equations may be advantageously employed in the discussion of Fresnel’s wave surface.

I have not attempted to make a complete catalogue even of all his most important works; I have said nothing of his papers on Fluctuating

Functions; on the Calculus of Probabilities; on the Calculus of Principal Relations; on the Argument of Abel to prove the Insolubility of Equations of the Fifth Degree; on Differences of Zero; on Geometrical Nets in Space. Any one of these memoirs would have been sufficient to make the reputation of a mathematician

HAMILTON was gifted with a rare combination of those qualities which are essential instruments of discovery. He had that fine perception of analogy by which the investigator is guided in his passage from the known to the unknown. This is an instrument by which many important mathematical discoveries have been effected. Sometimes the mathematician devises some happy modification in the statement of a theorem or a method, by which its application may be extended. Sometimes, by analyzing different demonstrations, he even sees that a particular proposition may be made the starting point from which he ascends to more than one generalization. In the investigations of HAMILTON we find abundant instances of the skilful use of all the ordinary expedients and instruments of inventive sagacity. But he seems, also, to have possessed a higher power of divination—an intuitive perception that new truths lay in a particular direction, and that patient and systematic search, carried on within definite limits, must certainly be rewarded by the discovery of a path leading into regions hitherto unexplored. Something like this was the unshaken assurance which led Columbus to turn his back upon Europe, to launch upon the broad Atlantic, and seek a New World in the far-off West.

And our illustrious countryman's diligence in research was not less admirable than his prescient sagacity. No amount of labour to be incurred could deter him from entering upon the calculations by which the correctness of his conjectures was to be tested. The confident expectation of obtaining results instructive in one way or another reconciled him to the irksomeness of the most tedious and complicated calculations. He felt that the great object to be sought, in the first instance, was the discovery of the result itself; and he trusted that, once it was reached, he would be able to strike out some more direct and more elegant method of investigation. His MSS., even his published researches, furnish many examples of this. Once he had reached the conclusion at which he had been aiming, he resumed the consideration of the principal steps in his argument; he interpreted them with care; he traced their connexion, and seldom failed to arrive at simplifications and generalizations, which amply compensated for the labour spent upon his first essays. By this habit of grappling courageously with the difficulties of calculation he was distinguished from some other eminent mathematicians. Averse to plunge into depths of calculation from which they see no certain hope of emerging in the end, they are tempted to expend an undue amount of intellectual energy in the endeavour to force their way by a direct method to the desired result.

Whilst touching on this point, I cannot help reverting to another mathematician of whom Ireland is justly proud—the late Pro-

fessor Mac Cullagh. I have seen him sit for hours with his paper before him, and all the outline of an elaborate investigation placed upon it. All the while he never took up his pen to execute the work which he had planned. He continued to brood over his task, and scanned it on every side, in the hope of being able to avoid the necessity of going through some "sea of trouble," in the shape of lengthened analytical computations. His taste in mathematics was refined—almost fastidious; and he could not bring himself to look with approval upon any demonstration which appeared wanting in symmetry and elegance. I must not be understood as in the least depreciating Mac Cullagh's power and skill in calculation. His researches in physical optics prove that he possessed these qualities in the highest degree. I only state the fact, that he sometimes was tempted to subject his faculty of mathematical insight to a painful and dangerous strain, in order to avoid the irksomeness of labour that was little more than mechanical.

In the case of HAMILTON, it is, moreover, deserving of notice, that he evinced a readiness to grapple with the difficulties of calculation, even where there was no prospect of his labour being rewarded by any discovery. He engaged in exercises of this kind sometimes from a wish to strengthen his intellectual hold of general propositions by scrutinizing the results obtained, by applying them in a number of particular instances; and sometimes, perhaps, from a wish to mature and keep in exercise those powers of calculation upon the exactitude and prompt operation of which so much depends in the conduct of difficult mathematical investigations. I have known him spend hours, or even days, in working numerical examples of some theorem in pure or applied mathematics, or in testing the accuracy of some formula of approximation. Occasionally he engaged in tasks of this nature, in the kindly endeavour to convince some half-crazed squarer of the circle that his proposed construction was inaccurate. Finding almost always that it was hopeless to convince the mathematical fanatic of the unsoundness of any of his premises, he would take pains to show him that the results he obtained were false in particular instances.

And this leads me to notice a feature in his character which deserves to be recorded. From the lofty height of his genius and learning he was accustomed to stoop with the utmost readiness to hold intellectual converse with inferior minds. Many of his visitors at the Observatory, and the members of the class who attended his lectures in Trinity College, can recall instances of his patience and good nature in answering their questions, and clearing up the difficulties which beset them in their elementary studies of mathematics and natural philosophy.

It is remarkable that, while he possessed such powers of calculation, and was almost prodigal in the exercise of them, he was to the last degree solicitous about the metaphysics of every subject on which he undertook to write. We have seen a decisive instance of this tendency of his mind in his treatment of algebra considered as the science of pure

time. So, again, in laying the foundation of his Calculus of Quaternions, we see him labouring to secure its stability by the most careful regard to the primary conceptions of time and space. Students of his lectures on Quaternions have sometimes complained that he has claimed from them too much attention to the metaphysics of the subject, and has stopped them in their career of building up, in order that they might contemplate afresh the plan of the structure. But this was in accordance with his views regarding the ascending scale of the subjects of human thought. To religion he gave the highest place, and this not as a formality; for his was a deeply reverential spirit. He assigned the next to metaphysics. To them he subordinated mathematics and poetry, and assigned the lowest place to physics and general literature. His studies in the department of metaphysics were extensive. After a thoughtful examination of Berkeley's writings, he professed himself a disciple of that philosopher, "with most cordial and delighted submission;" not, indeed, assenting to every separate argument, but embracing his grand results; and in this attachment to Berkeley's theory we have reason to know that he was confirmed by his converse with Faraday, who, in his own region of investigation, had been led to the conclusion that forces, rather than material particles, were the ultimate objects of physical inquiry. His acquaintance with the German language enabled him to master the works of Kant. In the reasonings of that philosopher he was the more ready to concur, as his own previous inquiries had already conducted him to several of Kant's views respecting the intuitions of time and space.

The literary attainments of HAMILTON were of a high order. At an early period of his life he gave surprising proofs of his power in acquiring languages; and though in after years he made but little display of these acquisitions, there can be no doubt but that his familiar acquaintance with the great Classic writers, and the ease with which he could read works written in the Continental languages, contributed to the culture of his taste and the force of his imagination, as well as to the facility with which he prosecuted studies of a professional kind. In the literary part of his Collegiate course he was not less eminent than in his scientific studies. He was a successful competitor on two occasions for the Vice-Chancellor's Prizes, proposed for the authors of English poems; and his examiners placed on record a judgment indicating their sense of his extraordinary proficiency in the Greek language, as well as a similar attestation of his remarkable attainments, for an undergraduate, in astronomical science. He continued all through his life the devotion to literature of which he gave these early proofs. He read widely, with an intense enjoyment of all that was excellent, and with the discrimination of a practised critic. With many of the distinguished authors of his time he was on terms of friendship: Miss Edgeworth, Mrs. Hemans, Wordsworth, Southey, and Coleridge were his friends and correspondents. With such tastes and associations, it was not to be wondered at if he, from time to time, gave vent to his poetic feelings in verse. These

compositions were not mere prolusions—exercises in versification—the promptings of a vain desire to excel in walks different from those in which his chief distinctions had been gained. They were the genuine outpourings of a noble heart and fervid imagination, characterized by a depth of thought and elevation of sentiment which compensated for occasional defects in artistic execution. These poetic efforts have an additional interest, as exemplifying in his own productions the connexion which he so strongly insisted on as existing between the highest provinces of science and the region of poetry—in both of which he maintained that there was scope and demand for the exercise of the imaginative faculty. According to him, the modern geometry, which deals with the infinites and imaginaries of space, has its beauty and its fascination; and he reckoned the happy daring of such geometers as Poncelet and Chasles as closely allied to poetry. We happen to know that this view of his, as communicated by him to the poet Wordsworth, was to the latter an entirely new revelation, and had the effect of raising his conception, which had before been unduly depreciatory, of the dignity both of science itself, and of its most eminent votaries.

Literary and scientific men are often censured, and not without reason, for their want of capacity in the transaction of business. To this reproach HAMILTON was not liable. He had a retentive memory, which enabled him to keep himself familiar with matters of detail; and a love of method, which manifested itself in systematic arrangement of any work which he had to perform. I believe that there never was a President of this Academy who had such a minute acquaintance with its affairs—such an exact knowledge of its history and constitution; and, consequently, whenever questions arose respecting its laws and usages, he was generally able to solve them by an immediate reference either to established rules, or to the Minutes recording the acts of the Academy or its Council. Nor was he less remarkable for qualities as necessary in the post he occupied, and of greater moral worth—for graciousness, combined with truthfulness, for a perfect freedom from all unworthy jealousy, and for a just sense of the dignity of the body over which he was called to preside.

Of his efficiency in the transaction of public business he gave signal proof at the time of the first Meeting of the British Association of Science in Dublin. He took an active part, along with Dr. Lloyd and a few other distinguished men of science, in those preliminary movements by which the governing bodies of Trinity College and the Academy were induced to invite the British Association to hold its meeting in this city in the year 1835. On that occasion, being appointed one of the Secretaries for the year, he discharged the duties of his office with a zeal and efficiency which procured for him the cordial thanks of all who took part in the proceedings. It thus fell to his lot to prepare the Annual Address usually read at the first general meeting of the Association. In that Address, though it was delivered thirty years ago, many of you will remember with what eloquence he expounded the working of the social spirit in promoting the progress of science. He explained

to the thousands who listened to him the means, the instruments, the processes which are contained in the operation of that spirit. He told them the men of science assembled there met and spoke and felt together then, that they might afterwards better think and act and feel alone. He told them that it is indeed the individual man who investigates and discovers—not any aggregate or mass of men; but, recognising in the fullest manner the necessity for individual exertion, and the ultimate connexion of every human act and human thought with the personal being of man, he forcibly reminded his hearers that the social feelings make up a large and powerful part of that complex and multiform being. “The affections,” he said, “act upon the intellect; the heart, upon the head. In the very silence and solitude of its meditations, still genius is essentially sympathetic—is sensitive to influence from without, and fain would spread itself abroad, and embrace the whole circle of humanity.” And then he proceeded to descant upon the influence which the love of fame exerts in quickening the efforts and cheering the labours of the greatest intellects. The passage is worthy of being referred to for its eloquence alone. But it has for us a special value; because it reveals to us something of the inmost mind of HAMILTON himself, and accounts for traits in his character which were not understood or viewed as indulgently as they ought to have been.

A mathematician endowed with such original powers as HAMILTON possessed might have been excused, if, yielding to the natural temptation of waiting for casual inspirations, he had carried on his labours in a desultory or unsystematic manner. To such temptations—and no doubt he felt them—he rose superior. He was, on the contrary, remarkable for the diligence and method with which he performed all his work. These qualities are evidenced by the number, magnitude, and importance of his published works. There was no minute care, even in matters of typographical nicety, which he disdained to expend upon them. And in his MS. books, carefully written, and with dates marking from day to day the progress of his scientific life, he recorded all his meditations, all the calculations through which he passed in his apparently fruitless, as well as in his most successful, researches. These volumes, many of them very large, and numbering about sixty, have been deposited in the Library of Trinity College. They will supply to future historians of science the most precious materials illustrating the development of HAMILTON’s discoveries. They will exhibit, doubtless, germs of thought suggestive to others of new discoveries. They record a great *commercium epistolicum*—his correspondence with the most distinguished scientific men of his own age. Nay, more, they will be found to contain memoirs on a variety of subjects, complete in themselves, and carefully elaborated, but which he had abstained from publishing, either because they were unconnected with the greater works which he had in hand, or because he hoped to develop them more fully at some future time. It is to be hoped that they will yet see the light, and, like the posthumous memoirs of Euler, inspire us with a feeling that

their great author is still holding converse with us. It will be a satisfaction to the members of this Academy to be told that his "Elements of Quaternions"—the work upon which he was engaged with the most unceasing activity for the last two years—is all but complete. I have reason to know that at no period of his life—not even when he was in the prime of health and youthful vigour—did he apply himself to his mathematical labours with more devoted diligence. Those who did not actually know how he was employed, or who had formed a false estimate of his character, might imagine him indolently reposing upon his laurels, or pursuing his studies in a desultory way. Such a conception of him would be the very opposite to the true one. His diligence of late was even excessive—interfering with his sleep, his meals, his exercise, his social enjoyments. It was, I believe, fatally injurious to his health.

Believe me, Gentlemen, the fame of SIR WILLIAM ROWAN HAMILTON, great as it was during his lifetime, will become yet greater when the world has been furnished with materials enabling it more perfectly to estimate the variety and richness of his endowments and the value of the services which he has rendered to Science. His reputation, even now, does not rest on the partiality of friends and countrymen. The learned men of all lands have already declared him worthy of the highest honours which can be paid to intellectual eminence. This world-wide recognition, at the present time, of his genius and discoveries, affords us a sure pledge and earnest of the perpetuity of his reputation, and warrants us in regarding his name as a glory which is not to pass away from the scientific and literary chaplet of Ireland. And in this fact and this anticipation we might thankfully and happily behold a full justification of his own early, and it might have been feared enthusiastic, aspirations—of his deep and generous consciousness that he was intrusted with faculties and powers capable of achieving in the noblest fields of thought a worthy fame both for himself and for his country. What were his feelings on this high subject of conscious power in connexion with fame his Sonnet on Shakspeare beautifully expresses; and I cannot better conclude my sincere but inadequate tribute to his memory than by repeating those moving and characteristic lines:—

"Who says that Shakspeare did not know his lot,
But deem'd that in time's manifold decay
His memory should die and pass away,
And that within the shrine of human thought
To him no altar should be reared? O hush!
O veil thyself awhile in solemn awe!
Nor dream that all man's mighty spirit-law
Thou know'st; how all the hidden fountains gush
Of the soul's silent prophesying power.
For as deep Love, 'mid all its wayward pain,
Cannot believe but it is loved again,
Even so, strong Genius, with its ample dower
Of a world-grasping love, from that deep feeling
Wins of its own wide sway the clear revealing."

I cannot doubt, Gentlemen, that I have had your sympathy in the ex-

pression of my regret and admiration for one who was your President—for one who, indeed, as a human being, had his share of human infirmity, but whose nobly countervailing greatness, both intellectual and moral, was such as every Irishman will long love to dwell upon.

It was resolved unanimously,

That the Academy deeply deplore the loss sustained by them in the death of Sir Wm. Rowan Hamilton, and return to the President their hearty thanks for the eloquent and touching address delivered to them.
